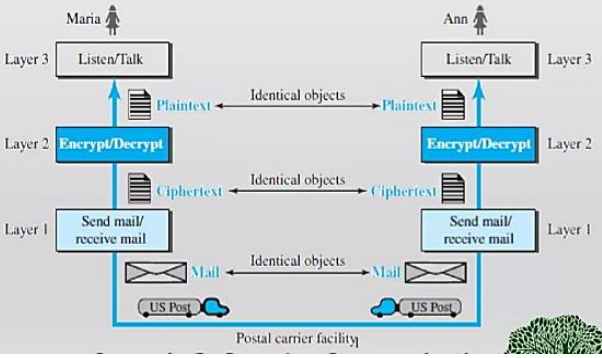
➢ EXPLAIN PROTOCOL LAYERING.

- In data communication and networking, a protocol defines the rules that both the sender and receiver and all intermediate devices need to follow for effective communication.
- When communication is simple, we may need only one simple protocol.
- when the communication is complex, we may need to divide the task between different layers.
- In this case we need a protocol at each layer, or **protocol layering.**

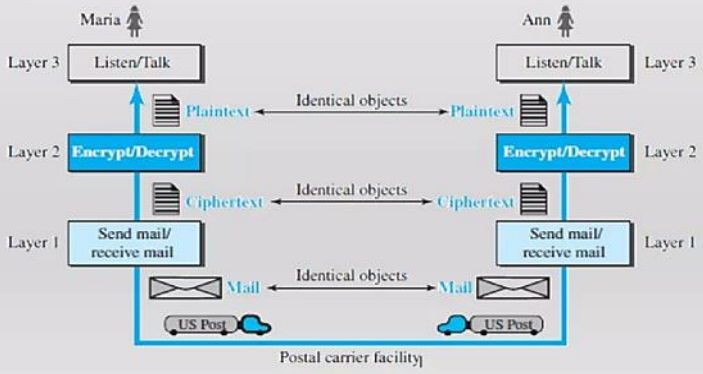
Scenario 1: Simple Communication



Principles of Protocol Layering

The **first principle** dictates that if we want bidirectional communication, we need to *make each layer so that it is able to perform two opposite tasks, one in each direction.*

The **second principle** that we need to follow in protocol layering is that the *two objects under each layer at both sites should be identical.*



➢ EXPLAIN OSI MODEL.

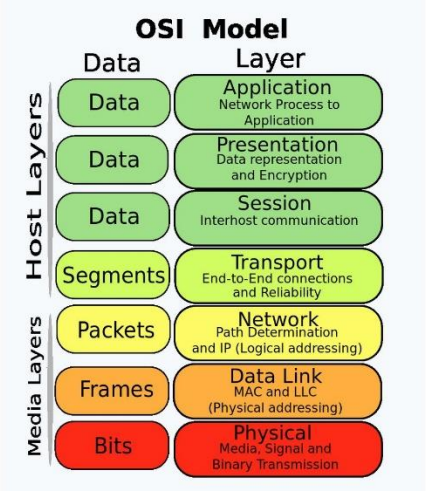
OSI stands for Open System Interconnection is a reference model that describes how information from a software application in one computer moves through a physical medium to the software application in another computer.

OSI consists of seven layers, and each layer performs a particular network function.

OSI model was developed by the International Organization for Standardization (ISO) in 1984, and it is now considered as an architectural model for the inter-computer communications.

OSI model divides the whole task into seven smaller and manageable tasks. Each layer is assigned a particular task.

Each layer is self-contained, so that task assigned to each layer can be performed independently.



The OSI model is divided into two layers: upper layers and lower layers.

The upper layer of the OSI model mainly deals with the application related issues, and they are implemented only in the software.

The application layer is closest to the end user.

Both the end user and the application layer interact with the software applications. An upper layer refers to the layer just above another layer.

The lower layer of the OSI model deals with the data transport issues.

The data link layer and the physical layer are implemented in hardware and software.

The physical layer is the lowest layer of the OSI model and is closest to the physical medium. The physical layer is mainly responsible for placing the information on the physical medium.

7 Layers of OSI Model

There are the seven OSI layers. Each layer has different functions. A list of seven layers are given below:

Physical Layer

Data-Link Layer

Network Layer

Transport Layer

Session Layer

Presentation Layer

Application Layer

1) Physical layer

The main functionality of the physical layer is to transmit the individual bits from one node to another node.

It is the lowest layer of the OSI model.

It establishes, maintains and deactivates the physical connection.

It specifies the mechanical, electrical and procedural network interface specifications.

Functions of a Physical layer:

Line Configuration: It defines the way how two or more devices can be connected physically.

Data Transmission: It defines the transmission mode whether it is simplex, half-duplex or full-duplex mode between the two devices on the network.

Topology: It defines the way how network devices are arranged.

Signals: It determines the type of the signal used for transmitting the information.

2) Data-Link Layer

This layer is responsible for the error-free transfer of data frames.

It defines the format of the data on the network.

It provides a reliable and efficient communication between two or more devices.

It is mainly responsible for the unique identification of each device that resides on a local network.

It contains two sub-layers:

Logical Link Control Layer

- It is responsible for transferring the packets to the Network layer of the receiver that is receiving.
- It identifies the address of the network layer protocol from the header.
- It also provides flow control.

Media Access Control Layer

- A Media access control layer is a link between the Logical Link Control layer and the network's physical layer.
- It is used for transferring the packets over the network.

3) Network Layer

It is a layer 3 that manages device addressing, tracks the location of devices on the network.

It determines the best path to move data from source to the destination based on the network conditions, the priority of service, and other factors.

The Data link layer is responsible for routing and forwarding the packets.

Routers are the layer 3 devices, they are specified in this layer and used to provide the routing services within an internetwork.

The protocols used to route the network traffic are known as Network layer protocols. Examples of protocols are IP and Ipv6.

4) Transport Layer

The Transport layer is a Layer 4 ensures that messages are transmitted in the order in which they are sent and there is no duplication of data.

The main responsibility of the transport layer is to transfer the data completely.

It receives the data from the upper layer and converts them into smaller units known as segments.

This layer can be termed as an end-to-end layer as it provides a point-to-point connection between source and destination to deliver the data reliably.

The two protocols used in this layer are:

Transmission Control Protocol

- It is a standard protocol that allows the systems to communicate over the internet.
- It establishes and maintains a connection between hosts.
- When data is sent over the TCP connection, then the TCP protocol divides the data into smaller units known as segments. Each segment travels over the internet using multiple routes, and they arrive in different orders at the destination. The transmission control protocol reorders the packets in the correct order at the receiving end.

User Datagram Protocol

- User Datagram Protocol is a transport layer protocol.
- It is an unreliable transport protocol as in this case receiver does not send any acknowledgment when the packet is received, the sender does not wait for any acknowledgment. Therefore, this makes a protocol unreliable.

5) Session Layer

It is a layer 3 in the OSI model.

The Session layer is used to establish, maintain and synchronizes the interaction between communicating devices.

Functions of Session layer:

- Dialog control: Session layer acts as a dialog controller that creates a dialog between two processes or we can say that it allows the communication between two processes which can be either half-duplex or full-duplex.
- Synchronization: Session layer adds some checkpoints when transmitting the data in a sequence. If some error occurs in the middle of the transmission of data, then the transmission will take place again from the checkpoint. This process is known as Synchronization and recovery.

6) Presentation Layer

A Presentation layer is mainly concerned with the syntax and semantics of the information exchanged between the two systems.

It acts as a data translator for a network.

This layer is a part of the operating system that converts the data from one presentation format to another format.

The Presentation layer is also known as the syntax layer.

Functions of Presentation layer:

- **Translation:** The processes in two systems exchange the information in the form of character strings, numbers and so on. Different computers use different encoding methods, the presentation layer handles the interoperability between the different encoding methods. It converts the data from sender-dependent format into a common format and changes the common format into receiver-dependent format at the receiving end.
- **Encryption:** Encryption is needed to maintain privacy. Encryption is a process of converting the sender-transmitted information into another form and sends the resulting message over the network.

- **Compression:** Data compression is a process of compressing the data, i.e., it reduces the number of bits to be transmitted. Data compression is very important in multimedia such as text, audio, video.

7) Application Layer

An application layer serves as a window for users and application processes to access network service.

It handles issues such as network transparency, resource allocation, etc.

An application layer is not an application, but it performs the application layer functions.

This layer provides the network services to the end-users.

Functions of Application Layer

- File transfer, access, and management (FTAM): An application layer allows a user to access the files in a remote computer, to retrieve the files from a computer and to manage the files in a remote computer.
- Mail services: An application layer provides the facility for email forwarding and storage.
- Directory services: An application provides the distributed database sources and is used to provide that global information about various objects.

➢ EXPLAIN TCP / IP MODEL.

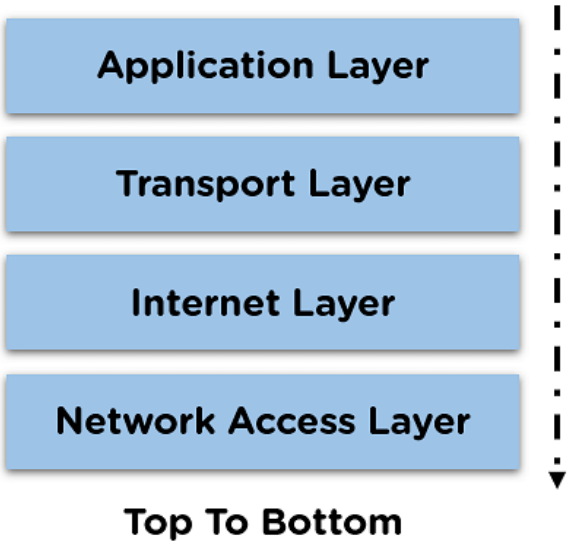
The TCP/IP model was developed prior to the OSI model.

The TCP/IP model is not exactly similar to the OSI model.

The TCP/IP model consists of five layers: the application layer, transport layer, network layer, data link layer and physical layer.

The first four layers provide physical standards, network interface, internetworking, and transport functions that correspond to the first four layers of the OSI model and these four layers are represented in TCP/IP model by a single layer called the application layer.

TCP/IP is a hierarchical protocol made up of interactive modules, and each of them provides specific functionality.



1. Link or access layer

The first layer of them all is the data link layer and here's where all the physical parts that are part of the information transfer and connection to the network are located. That is to say, the wireless network, the Ethernet cable, the controller, the network interface card…

Therefore, at this first layer, the information transfer reaches those components of the devices that make Internet access possible.

2. Internet layer

Now, when the information is already in the Internet layer, it means that we're already at the stage in which the sending becomes a tangible reality.

This is the level that is in charge of handling traffic routing and controlling the flow of traffic, which is why some people also refer to it as the internet layer.

Therefore, it's the internet layer that is responsible for ensuring that the files sent do not arrive damaged.

3. Transport layer

Then it will be time to meet the so-called transport layer.

As its name indicates, it's the one that functions as the information sending route, since it will provide the reliable connection that the devices need to send information to each other.

This is the layer that is responsible for dividing the information into several packets so that communication is effective and everything is received properly.

At the same time, it will be responsible for confirming that both parties involved have handled the data transfer properly and that the recipient has received the information.

At the same time, it will be responsible for confirming that both parties involved have handled the data transfer properly and that the recipient has received the information.

4. Application layer

Last but not least we have the application layer, which is the one with which we usually have the most direct contact on a day-to-day basis.

This is the level at which the information reaches the programs in which we can read it.

Therefore, within this level are all those applications through which the user in question can access the network and the information found there.